RP 503 Wind Turbine Reliability

The following recommended practice (RP) is subject to the disclaimer at the front of this manual. It is important that users read the disclaimer before considering adoption of any portion of this recommended practice.

This recommended practice was prepared by a committee of the AWEA Operations and Maintenance (O&M) Committee.

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Purpose and Scope

The scope of “Wind Turbine Reliability” focuses on data collection and the metrics for reporting and understanding overall plant reliability performance.

Introduction

The owner/operator bears the responsibility for collection of data and information for purposes of running the wind plant in a reliable and profitable manner. Reliability status reporting will be seen as failures, corrective and preventative maintenance, SCADA (time series) reporting, events, alarms, failures, MTBE, MTBF, downtime, maintenance costs, computerized maintenance management reporting (CMMS), and condition monitoring functions.

The following discussion recommends practices for data collection and the metrics for reporting and understanding of the overall plant reliability performance. Reliability, availability, and maintainability (RAM) metrics will have a role in this. RAM metrics provide reliability and availability trends, causes, sources, reasons, and impacts for plant downtime at the component level and provide field performance.

A subset of the data from every turbine’s control system, as well as data collected at the metering, substation, and grid connection interface, is typically held in one or more of the plant-wide supervisory control and data acquisition (SCADA) systems.

Introduction
(continued)

The O&M function is focused on maintaining generation at high levels and conducting preventative and corrective maintenance of the turbines, their components, and balance of plant. Production data by turbine should be maintained and analyzed for purposes of production engineering, which is important to overall plant O&M function.

Table A

kWh	Daily, weekly, quarterly, annually
Stop Hours	Daily, weekly, quarterly, and annually
Capacity Factor	Daily, weekly, quarterly, or annually
kWh/kW	

Wind Turbine Reliability

1. Event Data

Event data is needed to answer the basic questions of how often something fails, how long is it out of operation, and how much the down time costs. In other words, the symptoms, cause, and corrective actions for any failure or maintenance activity is a need that must be determined.

A record of each downtime event should be made.

Table B

Turbine ID	Distinguishes individual turbines
Event Code	Unique identifier for type of downtime event
Fault Code	Automated SCADA code that initiated the event
Event Name	Descriptive label for type of downtime event
Event	Start date and time
Event Type	Type of downtime (e.g., failure and preventative maintenance)
Event Duration	Hours of downtimes/return to service

It is important to track these metrics to individual components so that O&M planning, parts inventory and orders, manpower and equipment, and maintenance scheduling can be done as efficiently as possible.

2. Computerized Maintenance Management System (CMMS)

Work orders are often generated by plant managers to capture the need for repairs or other types of maintenance. A work order may have multiple purposes. It may be used for tracking of human resources or for tracking the time the turbine spent offline. For purposes of reliability tracking, work orders should document the investigation into the cause of outage and which component failed and/or was replaced, i.e. the root cause. In this way, work orders may provide insight into turbine performance and document operator actions which indicate the root cause of failure.

Ideally, work order systems will be computerized in an automated maintenance management system. Sandia has published a report entitled *Wind Energy Computerized Maintenance Management System (CMMS): Data Collection Recommendations for Reliability Analysis (SAND2009-4184)*. Combined SCADA and CMMS capabilities will enable reporting of recommended individual turbine metrics of:

- Operational Availability
- Wind Utilization
- MTBE (operating hrs.)
- Mean Downtime (hrs.)
- Annual Cost (per Turbine)
- Intrinsic Availability
- MTBF (operating hrs.)
- Mean Failure Downtime (hrs.)
- Annual Failures
- Failures Cost (per Turbine)
- Mean Fault Downtime (hrs.)
- Annual Fault Cost (per Turbine)
- MTB Scheduled Maintenance (operating hrs.)
- Mean Scheduled Downtime (hrs.)
- Maintenance Schedule
- Annual Scheduled Cost (per Turbine)

An ability to reconcile and harmonize SCADA and CMMS data is suggested as a recommended feature and capability for O&M and RAM functions in operating a wind plant. Getting organized to do this will provide tools to improve reliability and profits.

References

[1] R.R. Hill, V.A. Peters, J.A. Stinebaugh, and P.S. Veers, “Wind Turbine Reliability Database Update Appendix B: Report Template for Individualized Reports to Partners,” Sandia, Albuquerque, NM, USA, SAND2009-1171, 2009.
[2] B.L McKenney, A.B. Ogilvie, and V.A. Peters, “Using Wind Plant Data to Increase Reliability,” Sandia, Albuquerque, NM, USA, SAND2010-8800, 2011.
[3] V.A. Peters, P.S. Veers, and A. Ogilvie, “Wind Energy Computerized Maintenance Management System (CMMS): Data Collection Recommendations for Reliability Analysis,” Sandia, Albuquerque, NM, USA, SAND09-4184, 2009.